



MakerBot Replicator+ 3D Printer



Training:	Required
Reservation:	Required

You must be 18 to use the 3D printer without supervision.
Patrons between 12 and 17 may use the printer after taking a certification class and in the presence of an adult who is certified.

Certification

To become certified on this piece of equipment you will need to attend a training class that lasts approximately 30 minutes. By the end of the class you will be able to:

- Load and Unload Filament
- Download and process 3D .stl files
- Begin a 3D print job
- Remove your print job from the machine
- Clean up the workstation

To sign up for a training session please visit please see the calendar at norfolkne.gov/library.

Reservation

To reserve this piece of equipment you will need to first be certified on this equipment. After you have attended a training class for the equipment you may sign up for a time slot. To sign up for a time visit our website at <https://norfolk-ne.libcal.com/reserve/makerspace> to view available times and reserve a time.

Reference Sheet

Approved Materials:

Only MakerBot brand Filament may be used on the MakerBot Replicator+ this will be provided and charged at .10 cents per gram.

Build Volume:

11.6" x 7.6" x 6.5" (29.5 x 19.5 x 16.5 cm)

Layer Resolution:

.0039" (100 microns)

Filament Diameter:

0.069" (1.75 mm)

Nozzle Diameter:

.015" (0.4 mm)

Machine Accessories:

- Putty knife (for removing print)
- Onboard Camera

Important Information:

Filament that is not in use should be stored in plastic lock bags with desiccant pouches. Improperly stored filament will become unusable.

Workflow:

- Download or Design
- Process in MakerBot Print
- Setup Machine
- 3D Print Object

Remove finished part(s) and waste material

Software:

MakerBot Print

Tinkercad tinkercad.com

Fusion 360

MakerBot Replicator+

Materials and Software:

MakerBot Replicator+

MakerBot Filament

Putty Knife (for removing print)

Computer with MakerBot Print software

Overview

Makers will learn how to operate the 3D printer.

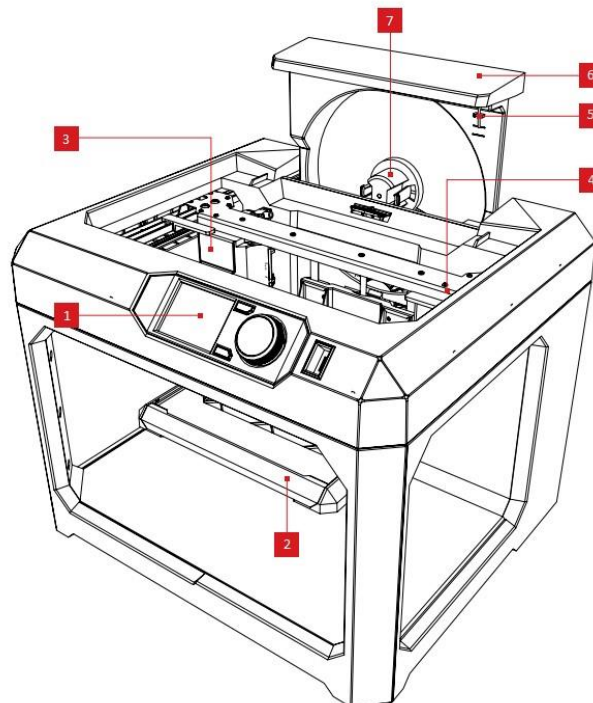
Safety

- The nozzle heats up to 424 °F and will burn skin.
- Hair and loose clothing may be caught in gantry. Long hair should be tied back, necklaces removed, sweatshirt strings tucked in, and long sleeves rolled up

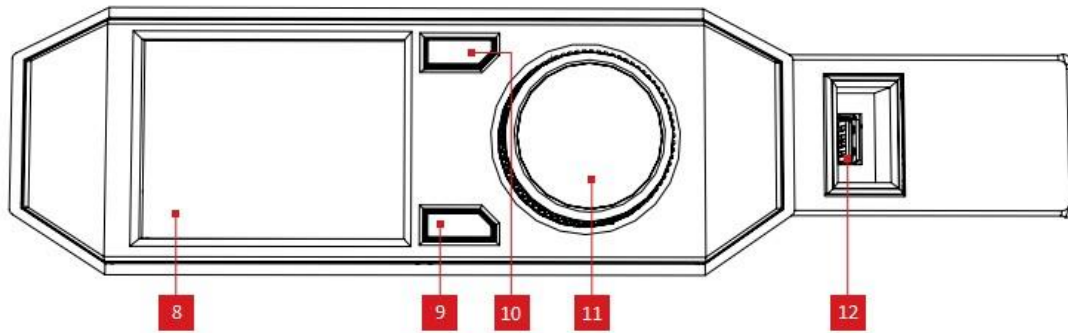
Set Up

Ensure machine is connected and powered on. Download the 3D print file in advance.

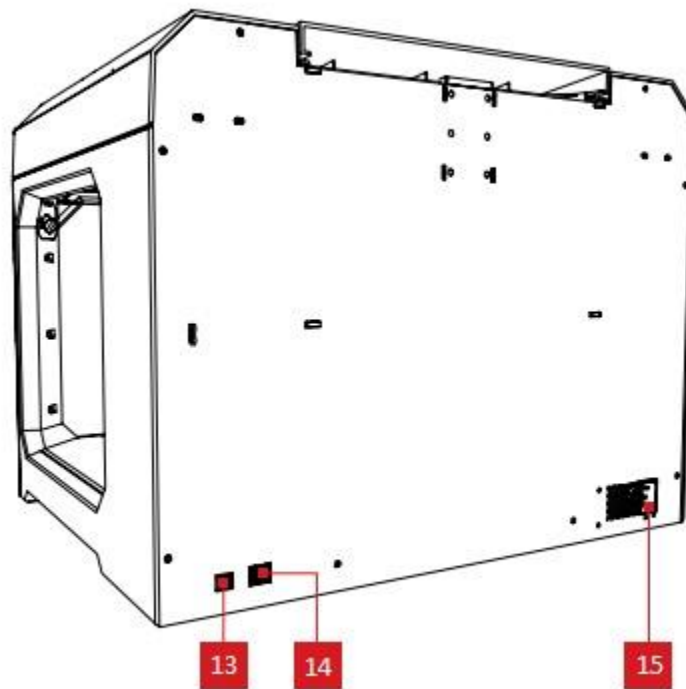
Machine layout - Front



Machine Layout - Control Panel



Machine Layout - Rear



- | | | |
|---------------------|------------------------|----------------------|
| 1. Control Panel | 2. Build Plate | 3. Extruder Assembly |
| 4. Gantry | 5. Filament Guide Tube | 6. Filament Drawer |
| 7. Filament Spindle | 8. LCD Screen | 9. Menu Button |
| 10. Back Button | 11. Dial | 12. USB Stick Port |
| 13. USB Port | 14. Ethernet Port | 15. Power Input Port |

Key Concepts

3D Modeling

3D modeling is the practice of using a virtual workspace in a computer to design 3 dimensional parts. Some 3D modeling programs cater to engineering purposes and are very accurate and precise, requiring the user to enter exact decimal dimensions. Other programs may cater towards artists that can work with a virtual piece of clay, stretching, pulling, and shaping it to their desired shape.

3D Printing

3D printing uses various technologies to bring a virtual 3D model into real space. There are 9 different categories of 3D printing ranging from melting and depositing material onto a build plate (FDM) to using ultraviolet light to selectively cure liquid resin (SLA). Each kind of 3D printing has its own set of challenges and costs associated with it.

FDM (Fused Deposition Modeling)

FDM printing is the most common and most affordable type of 3D printing. It utilizes a spool of plastic that is heated to the point where it will flow and bind to itself to create models. This type of 3D printing does come with some limitations.

The material must be a thermoplastic that melts within a certain temperature band, effectively limiting the material to about 10 different kinds of plastics.

Geometry is limited to parts with no overhangs, or areas that are unsupported below, and size based on the actual machine.

Unloading Filament Spool

If there is no spool loaded in the machine go directly to “Loading Filament Spool”. The MakerBot Replicator+ is directly controlled from the control panel using a bottom “Back Button”, a top “Menu Button”, and a dial that also clicks (See Machine Layout - Control Panel). To change the filament rotate the dial to “Filament” and then press the dial. From here select “Unload Filament”. The Replicator+ will walk you through the process of removing the filament.

1. When the filament is ejected from the extruder you may lock the filament drawer by pressing down on the toggle lock and lifting the filament drawer (Figure 1).
2. Rotate the spool clockwise to retract the filament, and gently press the tabs on the filament spindle while pulling the spool towards you to remove it from the machine.
3. Once removed be sure to properly feed the filament through the filament holder holes on the spool (Figure 2) so as not to unwind the whole spool. Unused filament spools should be kept in plastic bags so that they aren't affected by changes in humidity.



Figure 1 - Opening and Closing the Filament Drawer



Figure 2 - Securing Loose Filament

Loading Filament Spool

To load new filament onto the machine first open the filament drawer by pressing the toggle lock and lifting the filament drawer up (Figure 1).

2. Remove the new roll of filament from the zip top bag and pull the filament out of filament holder holes to allow the filament to unwind. Press the spool onto the filament spindle (Figure 3). When properly loaded the MakerBot logo is not visible on the spool.
3. Feed the filament into the red filament guide tube until about 1 inch of filament extends past the Filament Guide Tube.
4. On the control panel navigate to “Filament” and press the dial. From here use the dial to select “Load Filament” The Replicator+ will guide you through the process of loading the new filament.
5. When you are finished the filament guide tube should be securely held in the extruder assembly. You may lower the filament drawer by holding the lid of the drawer and pressing the toggle switch (Figure 1). Remove and recycle the waste PLA that was extruded.



Figure 3 - Loading Filament Spool



Figure 4 - Installed Filament Spool

Process in MakerBot Print

Open the MakerBot Print application. If this is your first time running the application follow the dialogues to create a MakerBot account. A blank print area will appear (Figure 5).

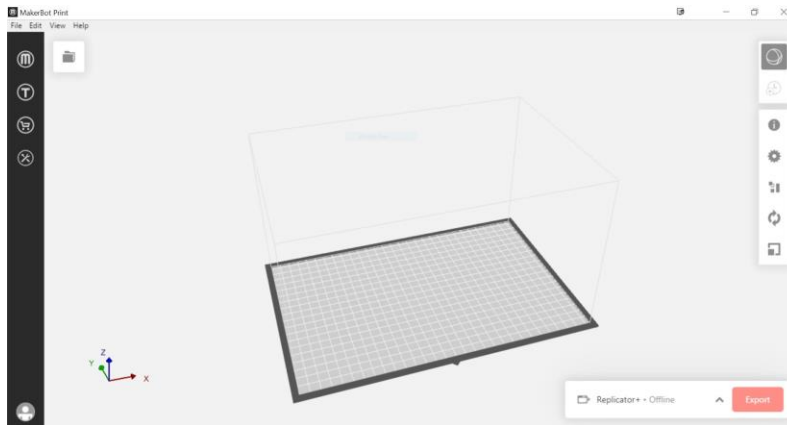


Figure 5 - MakerBot Print Interface

2. Open the Project Panel (file icon) In the upper left hand corner. To add our model to the build plate select “Add Models” and add the example file. To move the view around, click and hold the middle mouse button while moving the mouse to pan. Click and hold the right mouse button while moving the mouse to rotate. Scrolling up will zoom in on the cursor and scrolling down will zoom out of the cursor. Clicking and dragging on the object lets you move it around the build plate. Pressing delete when the model is selected will remove it from the build plate.

3. In the upper right hand corner there are six buttons to edit your object and print settings (Figure 6).

4. Clicking on the first icon (labeled 1) will show an estimate of print time and how much material will be consumed.

5. Clicking on the second icon (labeled 2) will allow you to adjust the units the model was imported in. If your object scale is very different from what you expected try changing units to achieve your desired scale.

6. Clicking on the third icon (labeled 3) will allow you to change the print settings. There are multiple custom settings not covered in detail here. Some options that you may enable are:

- a. “Support” creates removable structures that allow objects with overhangs to print, by default it’s best to leave this enabled.
- b. “Infill Density” allows you to decide how solid your object is. 0% is completely hollow and 100% is completely solid.
- c. “Layer Height” decides how fine the layers are, a smaller layer height will look better but will take longer to print.

7. Click on the fourth icon (labeled 4) to automatically arrange multiple items on the build plate. Because there is only one item on the build plate it will not do anything for this job. Click the fifth icon (labeled 5) to orient the part. Some parts will print better when they’re facing a certain direction, if your print doesn’t succeed try orienting it differently.

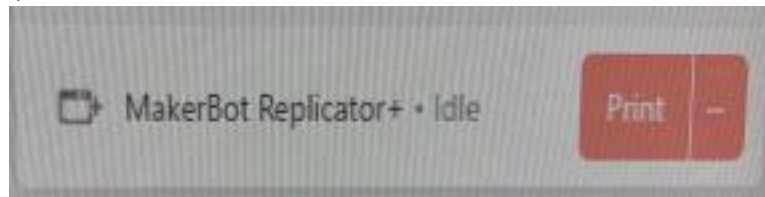


Figure 6 -
MakerBot Print
Edit Options

- Click the sixth icon (labeled 6) to scale the object. Make sure “Uniform Scaling” is selected or the object will distort when scaling. Change any of the percentage values to 75% and press enter to scale the object.

Sending your file to the Printer

- When you are ready to print make sure the MakerBot Replicator is turned on and connected to your computer. In the lower right hand corner of the MakerBot Print application click on the box labeled “Replicator+” or “Select a Printer” (Figure 7). Select the Online Replicator+. Press the red “Print” button in the lower right hand corner and the software will begin generating the necessary code.



- The MakerBot Print Software will show an estimate of how much filament will be used (Figure 8), check that against the amount of material remaining on the spool, you may need to cancel the job and insert a new spool of filament.

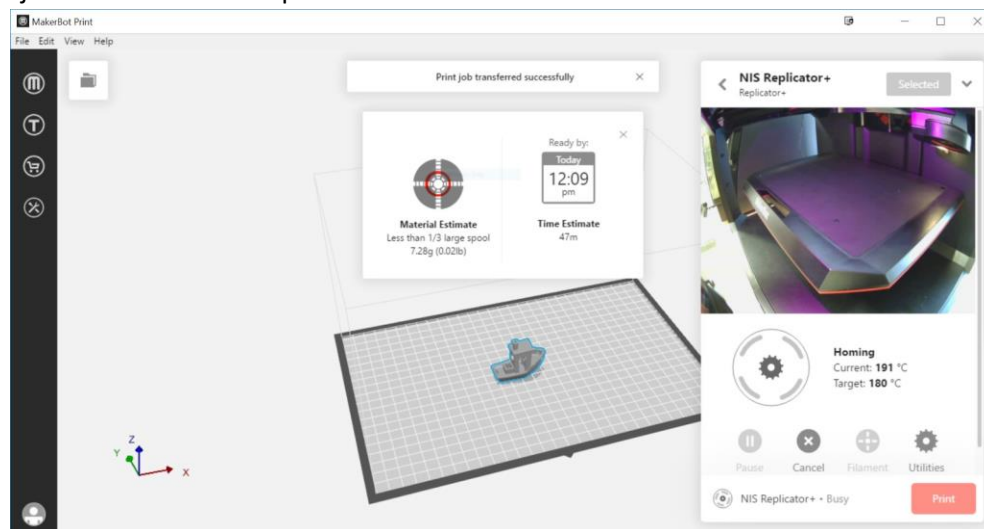


Figure 8 - MakerBot Print Estimates

- The MakerBot Print Software will also give an estimate of the time it will take to print your job (Figure 8).
- The MakerBot replicator will begin initializing and heating the extruder head.
- When the MakerBot Replicator+ is printing the Control Panel will show “Time Elapsed” and an estimate of “Time Remaining.”

6. Stay with the machine and make sure the initial layer properly adheres, after it proceeds to the second layer you may walk away from the machine.

Removing your object from the build plate

1. When the MakerBot Replicator+ is done with the print job it will lower the build plate and the screen will show the job is finished. Some objects will easily pull off of the bed but if the object is stuck you can remove the build tray from the MakerBot Replicator+ and flex it (Figure 9).



Figure 9 - Removing the Build Plate

2. If your print does not come off after flexing the build plate you may slide the putty knife under it (Figure 10).
3. When you are finished printing on the machine make sure the area is picked up and the MakerBot is powered off. Any loose filament may be recycled.
4. Go to the Library Service Desk and pay for your 3D Prints. The filament is charged at .10 cents per gram. It is based on the grams that the Makerbot print application estimates.



Figure 10 - Removing Stuck Pieces

Additional Resources

3D Model Repository - Thingiverse

<https://www.thingiverse.com/>

Beginner Design - TinkerCAD

<https://www.tinkercad.com/>

Advanced Design – Fusion360

<https://www.autodesk.com/products/fusion-360/>

Makerbot Replicator+ Educator's Guidebook

https://pages.makerbot.com/rs/444-ZTM-866/images/MakerBot_Educators_Guidebook_vf2.pdf